IAF-92-0473

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An Adventure in Exploration

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43rd CONGRESS OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION

August 28-September 5, 1992/Washington, DC

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MARSVILLE - THE COSMIC VILLAGE AN ADVENTURE IN EXPLORATION

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Abstract

Marsville - The Cosmic Village is the first program in "Adventures in Exploration," Challenger Center's series of classroom based mission simulations. This paper summarizes Marsville's implementation during International Space Year and its structure under the format of the Challenger Center's instructional model, the Challenger Way. This model stresses: content instruction, team work, critical thinking and problem solving, and responsible decision-making.

Background

The Challenger Center for Space Science Education is a nonprofit educational organization with a mission to increase the number of elementary and middle school students interested in science, and to reverse the negative feelings many youngsters have about science and technology. The Challenger Center was established in 1986 by the families of the Challenger shuttle crew as the most appropriate way to continue the Challenger crew's educational mission: to teach, to explore and to inspire.

Challenger Center uses the excitement of space exploration to capture children's interest. Through interesting and hands-on, problem-solving, space-related activities, children experience first-hand the opportunities and satisfactions offered by science and technology. To ensure reaching the broadest possible group of schoolchildren nationwide, Challenger Center operates through a distinctive series of collaborations with local schools, science centers and museums, government agencies and community organizations.

Challenger Center's core educational program is the Challenger Learning Centers. There are currently fourteen international Learning Centers in what is expected to grow to a 30-site network by 1995. The Learning Center sites form a network of high-technology space-flight simulators for exciting hands-on learning experiences.

Challenger Center offers programs in addition to the Challenger Learning Centers. These programs serve to strengthen the Challenger Learning Center experience for students and teachers, or to introduce the experience to areas which currently are without a Learning Center.

1) **Satellite Learning Network** is a continuing series of teleconference programs for classrooms featuring space-based lessons, "call-in" interviews, activities and materials for the classroom.

2) **Touching the Future: Linking the Classroom with Space** is a series of teacher training workshops led by Challenger's National Faculty the core of whom are NASA Teacher-In-Space finalists. This program uses space-based teaching and curriculum materials designed to be effective tools and strategies for teaching science.

3) **Adventures in Exploration** is a series of educational projects involving students from around the world in year-long space mission simulations designed to address the challenges of problem-solving in multicultural settings. "Marsville - The Cosmic Village" is the first program in the Adventures series.

Marsville: Scope of the Project

"Marsville -- The Cosmic Village" was endorsed as one of the lead educational projects for International Space Year by the Space Agency Forum meeting in Kyoto, Japan, in May 1990 and again in Moscow, May, 1991.

Marsville leads students to an increased appreciation of the fragility of the Earth's environment by using Mars as an analog. Except for a few robotic probes, Mars is a pristine world untouched by human presence.

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Examining and learning from the historical experience of their home planet's development, students are asked to create a new human world, a multi-racial settlement on Mars. Students become pioneers of the space frontier.

While the primary educational thrust in Marsville focuses on science, math, technology and communications, the project will use a cross-curricular, holistic approach bringing in the social and political sciences as well as the humanities (arts, language, music) when appropriate.

The purpose of Marsville is to create for young people from around the world a positive vision of the technological society of the twenty-first century, and of their role in making it a reality.

Its objectives are:

- To teach math, science, technology, engineering and communications concepts.
- To demonstrate problem solving using a cooperative model.
- To arouse student's interest in pursuing careers in the sciences, communications, and technology.
- To promote international understanding among youth and increase students' awareness of, and respect for, multi-cultural perspectives.
- To expose students to the complex scientific, technological, environmental, socio-political, and cultural issues related to space exploration.
- To provide students with positive role models from the fields of science and technology.

When the American pioneers went west, they literally left the United States at the Mississippi border and entered truly uncharted territories. Faced with problems they had never imagined, they had to create brand new answers.

How do you build a cabin when you have no logs? You make bricks from soil. Hide from a tornado? Dig a cellar. And if you have no state constitution (because you aren't a state yet), the home rule of each sheriff in each town must resolve many conflicts.

Just like the pioneers who lived years before them, students will be pioneers, too; but their territory will be the planet Mars. Together with fellow pioneering teams they have not yet met, they will create brand new solutions to basic human problems.

Marsville Overview

Marsville is a joint project of Challenger Center and the Educational Information and Resource Center (EIRC) in New Jersey, USA. It was field tested in April 1991 with 220 students who were part of EIRC's network of schools and programs. In August 1991, Challenger Center's National Faculty were trained as coordinators to manage all phases of Marsville in their home communities.

Challenger Center was also fortunate to have the support and participation of corporations and NASA Space Grant Consortium Universities. Gifts for development and implementation were received from the Emil Beuhler Foundation, the Houston Endowment, IBM, NYNEX, Rockwell International, Rotary and TRW. The Space Grant consortium of Universities in Colorado, Louisiana and Nevada sponsored and hosted Marsville in their states.

Marsville is a multi-disciplinary program intended as a teaching strategy to enable teachers to satisfy their curriculum objectives in a variety of subjects matters. It has been implemented in school curriculums for lengths of up to four months, though it could easily be threaded throughout the entire school year. Students' classroom work in Marsville culminates with the Link-Up Day in which students meet to actually construct the Martian settlement.

Marsville took place in 30 separate sites this year and included approximately 6,000 students. The sites varied in participation with the smallest including 21 students, to the largest having over 600 students.

The classroom materials for Marsville include a guidebook, videotape, and the poster "An Explorer's Guide to Mars." The guidebook contains the project's guidelines and activities. The videotape has four segments: a music video, created by a Challenger Center fellowship winner and his

class as a prime example of the project's interdisciplinary potential; labeled footage from an actual Link-Up Day; the Jet Propulsion Laboratory's computer simulation "Mars: The Movie"; and "Exploring Mars with the Viking Spacecraft," a visual encyclopedia of Mars information. The Planetary Society's poster, "An Explorer's Guide to Mars," is a visually striking map of Mars with a wealth of planetary information.

Workshop

Teacher preparation is an important factor that was realized in field testing. The test group, though familiar with similar programs, required frequent contact with their coordinator throughout Marsville. However, during its implementation this year, there has been almost a complete elimination of this due to the introductory workshop.

The Marsville training workshop uses an experiential approach to learning so the teachers will: know the various parts of Marsville; understand the relationship of the various parts of the Challenger Way; know which parts are within their school only, between schools before Link-Up Day, and for the Link-Up Day only: and to understand their role as a Marsville teacher.

Participating teachers work through Marsville under the guidance of their local coordinator. The beginning of Marsville is signified by the five hour teacher workshop which is given for participating teachers by their site coordinator. The workshop begins with brief excercises designed to illustrate the four points of the Challenger Way.

Teachers discuss the importance of **teamwork** and individual roles within the team. They work in teams throughout the workshop just as the students will work in teams throughout the project.

The teachers then learn facts about Mars using comparisons to Earth. They will not be required to be Mars "experts." However, this stresses all project work is to focus on **academic content**. Additionally, they find that as a team fact gathering is a more manageable activity.

The next exercise incorporates **creative and critical problem solving** ability to determine what systems are required to support life on Mars. Marsville incorporates eight separate life support systems (air supply, communications, food production and delivery, recreation, temperature control, transportation, waste management and water supply) and the teachers are then given a team assignment for the length of the workshop.

Then to complete their introduction to the Challenger Way, each team creates a priority list of systems' implemention. In this **responsible decision making** activity they consider: to whom or what they are responsible; what could be the consequences of each potential decision; and what could be the consequences of not making a decision.

The remainder of the workshop exactly mimics the project tasks which the students will undertake in which they are creating their life support systems, team uniforms, and lunches and are working cooperatively with other teams to design and build their habitats.

Design

Planning Marsville

Students in classrooms around the country plan Marsville, the prototype Martian community of the future. "Mission teams" consisting of 5-7 students with a teacher/mentor solve simulation-based problem sets.

Students are asked to consider questions such as:

- What is a pioneer?
- Why do people become pioneers? What motivates them and sustains them?
- What problems do pioneers generally face? What are their "life support" needs in a new and potentially alien environment?
- How did pioneers historically deal with the wide range of problems facing them?

Students also work in their teams to consider the physical realities of life on Mars using their knowledge of Earth as a background to solve problems such as:

- How will the settlement feed itself?
- What will provide the most efficient energy needs?
- How will waste products be treated so as not to pollute the Martian environment?
- What recreational and communication systems will be needed for humans to interact effectively?

Each mission team is assigned one of eight life support systems: air supply, communications, food production and delivery, recreation, temperature control, transportation, waste management or water supply. The design of a life support system for the Martian settlement forms the vehicle for the students' acquiring **content knowledge**.

The students build two or three dimensional models of their systems. These models are not required to actually function, but the students must be able to explain the rational as to how and why they should work. A section of facts on Mars, the Mars ABC's, is included in the guidebook, and the systems must incorporate at least four of these facts. (On Link-Up Day, the culminating event where students will gather to build Marsville, students will have the opportunity to test their Mars knowledge through the entire range of the Mars ABC's.)

The students employ **teamwork** in the design of their systems and use their **problem solving** skills to overcome the harsh Martian environment. **Responsible decision making** is employed as the students consider how their system will affect their environment as well as supporting life.

When the mission teams have completed construction of their systems, they are grouped with two other teams from two different schools to form a Habitat Crew. As a crew they will do the required planning, **problem solving**, and engineering to design and prefabricate their habitat.

They use faxes, telephones, modems, computer bulletin boards, etc. as their means of "telecommunication." Their only restriction on communication is that they may not meet face to face. This will test their **teamwork** abilities in the application of content knowledge in math, technology and communications, as well as modeling the cooperative and international nature of future space endeavors.

Though the actual habitats are constructed using plastic sheeting, duct tape and house fans, the accompanying materials provide necessary background on Martian atmosphere, terrain, "weather" and geology. Students will be asked to consider questions such as:

- What constitutes a human habitat?
- How did pioneers historically use available materials to fashion their habitats?
- What materials, shapes and structures would provide the most efficient and hospitable habitat for a human settlement?

Along with their work on life support systems and habitats, students complete additional activities to enhance their participation in Marsville. They are responsible for their lunch on Link-Up Day and for the design of a team uniform.

The teams must work together to determine their lunch. Each team is allowed 22 ounces per student and packs the lunch in as few bags as possible. The lunch must be nutritionally complete and hold 10 ounces of liquid. The teams also weigh their waste (containers and uneaten food) afterwards and are allowed a maximum of 2 ounces per student.

Lunch in Marsville requires students to apply mathematic **content knowledge** in determining the weight and volume of their lunch, and to utilize **teamwork** and **problem solving** to meet the specified requirements.

Designing their uniforms helps the students to develop team identity. Using **teamwork,** they decide on matching colors for their pants and shirts and design a mission logo that identifies their team and its mission.

<u>Building Marsville</u>

Mission teams convene at a central site for the one-day "LinkUp." (Host sites will be Challenger Learning Centers, science centers and museums, Space Grant Consortia Colleges and Universities or local schools.)

This is the first time they "meet" the students outside of their own team.

At each site the first task of the Habitat Crew (three mission teams from different schools) is to erect their habitat. Each team brings their agreed upon sections and materials and through **team work** and communication the Habitat Crew will build their habitat. The Marsville guidebook offers possible designs and it is required that at least two of the teams contribute building materials. The use of plastic and duct tape provides a forgiving medium that enables the students to experience success in this activity without requiring a precision in construction skills that may be detrimental to the project's objectives.

(Throughout Marsville, each team maintains a Mission Log. In the classroom and during the Link-Up Day, the teams track their progress on the Mission Log and are given points for successful completion of the various tasks for Marsville. The log is intended as a means of keeping students on task, and not as a competitive mechanism.)

When all habitats have been erected, the teams set up their life support systems within the habitat and are ready for the Celestial Questial. In the Celestial Questial students use their **teamwork** and communication skills to review scientific facts (**content knowledge**), or Mars ABC's, and identify how these facts were applied to **problem solve** supporting humans in Marsville.

Students are given roles as: Questers, to visit other habitats; Presenters who will be responsible for two-minute presentations regarding their team's system; and one student from each team of the Habitat Crew to fulfill a habitat role as either Air-Lock Controller, Timer, or Communications Controller.

Under the guidance of the site coordinator, the Questers visit other teams to hear their presentations. In these two-minute briefings, the Presenters will explain their systems highlighting three of the four Mars facts that were considered in its design.

The fourth fact is presented in the form of a multiple choice riddle, and the Questers are to choose the correct response. As a reward for a correct response, the Questers receive a bonus card from the Presenters in recognition of their knowledge, and the Questers give the Presenters a bonus card for a successful presentation. The number of bonus cards received is added to each team's Mission Log totals.

The "What If..." is a **responsible decision making** activity that relies on students applying their **content knowledge, teamwork and problem solving** skills to solve a problem scenario. The students work in groups to brainstorm possible solutions, and then to narrow down and choose a best solution with regards to the greatest good and least possible harm to the settlement.

During the "What If..." a group of students works as habitat connectors. They build tunnels that connect the habitats to each other, transforming the individual habitats into an actual settlement, "Marsville - The Cosmic Village."

The final activity of Link-Up Day is the Walk Through. Each team in turn will be allowed to walk through the settlement by means of the tunnels which connect the various habitats. This allows each student to view each of the systems and habitats.

Participants Comments

Though the formal evaluations are not yet completed, there have been universally positive comments regarding the Marsville experience.

Teacher comments

"The Mars content is kind of fun, but they're really doing something that's going to be happening someday."

"What the students are doing is amazing. By participating, they are learning about many subjects...and learning to work together."

"I've seen the kids excited by science before, but never as interested and excited as they where while working on the Marsville project."

"Very educational. They learned more today and doing their research than in the regular classroom."

"This is the best educational idea I have seen."

Student Comments

"Instead of reading about what Mars is like, we're actually experiencing it."

"I had a wonderful time at Marsville, even though it took lots of time and hard work. The Marsville experience was a wonderful way to learn facts about Mars."

Conclusion

Marsville uses a variety of tools to focus on the environmental needs of humans living on Mars for an extended period of time: food production, waste management, energy utilization, use of resources, advanced technologies and their applications, and other issues such as communications, transportation, and governance. The educational strategy is to use the establishment of this imaginary Martian biosphere as a dramatic tool for increasing students' awareness of Earth's environmental problems.

We face a broad array of technological challenges. Our ability to meet these challenges hinges on our ability to encourage excellence in science, math, and technology. We need to develop a scientifically literate, mathematically competent citizenry and a technologically skilled workforce to lead us into the 21st century. Through Marsville, the Challenger Learning Center network, and a wide range of educational programs, Challenger Center is doing its part to touch the future.